

VPC-Compass-SE®: Prediction and Modeling of Corrosion in Microelectronic Packages

Version 9.20

★ Performance ★ Functionality ★ Usability



Anytime Anywhere Any Device Any OS
No USB dongles No installation No Browser Plug-ins

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Why WebCorr | Performance Guarantee | Unparalleled Functionality | Unmatched Usability | Any Device Any OS | Free Training & Support | CorrCompass

Overview and Application Examples of VPC-Compass-SE

VPC-Compass-SE is the only device and OS independent software tool on the market for the prediction and modeling of corrosion in microelectronic packages. Designers, OEM engineers, QA/QC and inspection engineers can quickly determine the the risk rankings of corrosion and other reliability issues in microelectronic packages such as electrochemical migration (ECM), dendrite formation/metallic treeing, and surface conductivity. VPC-Compass-SE also predict the relative humidity or the moisture content in the internal cavity, the dew point temperature in the cavity, the number of monolayers of water on the internal surface, the thickness of moisture film on the internal surface, and the surface conductivity of the moisture film. VPC-Compass-SE works on any device running any OS without the need to install or download anything.

Figures below show the screen shots of VPC-Compass-SE.


VPC-Compass-SE®: Corrosion in Microelectronic Packages - Prediction, Modeling and Assessment				
Package description/ID		Device ID#123456		
Package design	Hermetic Non-Hermetic	Corrosion & ECM risk category Low corrosion/ECM risk		
Internal volume (cavity)	cm ³ 0.008	Relative humidity in cavity	%	17.167
Internal surface area to volume ratio	cm ² /cm ³ 30.000	Dew point temperature in cavity	°C	-6.675
Packaging environment (chamber)		Number of H2O monolayers	monolayer	3.107
Temperature	°C 22.000	Thickness of H2O film	nm	0.870
Moisture content	ppmv 4480.000	Conductivity of H ₂ O film	Ω ⁻¹ .cm ⁻¹	2.445e-11
SO ₂ content in vapor	g/m ³ 0.000	Under the current condition, there exists barely enough electrolyte to sustain low corrosion rate in the package. Electrochemical migration (ECM) risk is also low.		
H ₂ S content in vapor	g/m ³ 0.000			
HCl in vapor	g/m ³ 0.000			
HF in vapor	g/m ³ 0.000			
HBr in vapor	g/m ³ 0.000			

Figure 1 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM): design parameters

Users of VPC-Compass-SE start by selecting the package design from the dropdown list (hermetic and non-hermetic). Input parameters include the internal volume of cavity/headspace and the internal surface area (in cm²) to the volume (in cm³) ratio, as shown in Figure 2 below.


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Package design	Hermetic	Corrosion & ECM risk category Low corrosion/ECM risk		
Internal volume (cavity)	cm ³ 0.008	Relative humidity in cavity	%	17.167
Internal surface area to volume ratio	cm ² /cm ³ 30.000	Dew point temperature in cavity	°C	-6.675
Packaging environment (chamber)		Number of H2O monolayers	monolayer	3.107
Temperature	°C 22.000	Thickness of H2O film	nm	0.870
Moisture content	ppmv 4480.000	Conductivity of H ₂ O film	Ω ⁻¹ .cm ⁻¹	2.445e-11
Relative humidity	g/m ³ 0.000	Under the current condition, there exists barely enough electrolyte to sustain low corrosion rate in the package. Electrochemical migration (ECM) risk is also low.		
SO ₂ content in vapor	g/m ³ 0.000			
H ₂ S content in vapor	g/m ³ 0.000			
HCl in vapor	g/m ³ 0.000			
HF in vapor	g/m ³ 0.000			
HBr in vapor	g/m ³ 0.000			

Figure 2 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM): environmental parameters

Environmental parameters include temperature, moisture content/relative humidity, and other gases. If moisture content (in ppmv) is used as input, the relative humidity in the cavity will be predicted by VPC-Compass-SE; if the relative humidity is used as the input, the moisture content in the cavity will be predicted by VPC-Compass-SE, as shown in Figure 3 below.


VPC-Compass-SE®: Corrosion in Microelectronic Packages - Prediction, Modeling and Assessment				
Package description/ID		Device ID#123456		
Package design	Non-Hermetic		Corrosion & ECM risk category	Low corrosion/ECM risk
Internal volume (cavity)	cm ³	0.008	Moisture content in cavity	ppmv 15,657.755
Internal surface area to volume ratio	cm ² /cm ³	30.000	Dew point temperature in cavity	°C 12.190
Service environment (ambient)			Number of H2O monolayers	monolayer 10.858
Temperature	°C	22.000	Thickness of H2O film	nm 3.040
Relative humidity	%	60.000	Conductivity of H2O film	Ω ⁻¹ .cm ⁻¹ 5.125e-9
SO ₂ content in vapor	g/m ³	0.000	Under the current condition, there exists barely enough electrolyte to sustain low corrosion rate in the package. Electrochemical migration (ECM) risk is also low.	
H ₂ S content in vapor	g/m ³	0.000		
HCl in vapor	g/m ³	0.000		
HF in vapor	g/m ³	0.000		
HBr in vapor	g/m ³	0.000		

Figure 3 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM): input RH

Under the specified package design and environmental conditions shown in Figure 3 above, the risk of corrosion and electrochemical migration (ECM) is low as there exists barely enough electrolyte (moisture) to support the corrosion and/or ECM process. The predicted moisture content in the internal volume is 15,658 ppmv, the predicted dew point temperature is 12.19°C, the predicted number of monolayers of water on the internal surface is 11, the thickness of moisture film is 3 nm, and the conductivity of surface moisture is $5.12 \times 10^{-9} \Omega^{-1} \cdot \text{cm}^{-1}$. When the internal surface area to volume ratio changes from 30 to 10 (Figure 4 below), the risks of corrosion and electrochemical

migration are high. If, however, the internal surface area to volume ratio changes to 40 (Figure 5), there is no risk of corrosion or electrochemical migration.


VPC-Compass-SE®: Corrosion in Microelectronic Packages - Prediction, Modeling and Assessment					
Package description/ID		Device ID#123456			
Package design	Non-Hermetic		Corrosion & ECM risk category	High corrosion/ECM risk	
Internal volume (cavity)	cm ³	0.008	Moisture content in cavity	ppmv	15,657.755
Internal surface area to volume ratio	cm ² /cm ³	10.000	Dew point temperature in cavity	°C	12.190
Service environment (ambient)			Number of H ₂ O monolayers	monolayer	32.575
Temperature	°C	22.000	Thickness of H ₂ O film	nm	9.121
Relative humidity	%	60.000	Conductivity of H ₂ O film	Ω ⁻¹ .cm ⁻¹	5.125e-9
SO ₂ content in vapor	g/m ³	0.000	Under the current condition, there exists sufficient electrolyte to sustain long-term high corrosion rate in the package. Electrochemical migration (ECM) risk is also high.		
H ₂ S content in vapor	g/m ³	0.000			
HCl in vapor	g/m ³	0.000			
HF in vapor	g/m ³	0.000			
HBr in vapor	g/m ³	0.000			

Figure 4 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM): effect of surface area to volume ratio, high risk


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Package description/ID		Device ID#123456			
Package design	Hermetic		Corrosion & ECM risk category	No corrosion/ECM risk	
Internal volume (cavity)	cm ³	0.008	Relative humidity in cavity	%	17.167
Internal surface area to volume ratio	cm ² /cm ³	40.000	Dew point temperature in cavity	°C	-6.675
Packaging environment (chamber)			Number of H ₂ O monolayers	monolayer	2.330
Temperature	°C	22.000	Thickness of H ₂ O film	nm	0.652
Moisture content	ppmv	4480.000	Conductivity of H ₂ O film	Ω ⁻¹ .cm ⁻¹	2.445e-11
SO ₂ content in vapor	g/m ³	0.000	Under the current condition, there is no electrolyte (liquid water) to initiate corrosion or electrochemical migration (ECM) in the package.		
H ₂ S content in vapor	g/m ³	0.000			
HCl in vapor	g/m ³	0.000			
HF in vapor	g/m ³	0.000			
HBr in vapor	g/m ³	0.000			

Figure 5 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM): effect of surface area to volume ratio, no risk


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Package description/ID		Device ID#123456			
Package design	Hermetic		Corrosion & ECM risk category	Low corrosion/ECM risk	
Internal volume (cavity)	cm ³	0.008	Relative humidity in cavity	%	17.167
Internal surface area to volume ratio	cm ² /cm ³	30.000	Dew point temperature in cavity	°C	-6.675
Packaging environment (chamber)			Number of H ₂ O monolayers	monolayer	3.107
Temperature	°C	22.000	Thickness of H ₂ O film	nm	0.870
Moisture content	ppmv	4480.000	Conductivity of H ₂ O film	Ω ⁻¹ .cm ⁻¹	2.445e-11
SO ₂ content in vapor	g/m ³	0.000	Under the current condition, there exists barely enough electrolyte to sustain low corrosion rate in the package. Electrochemical migration (ECM) risk is also low.		
H ₂ S content in vapor	g/m ³	0.000			
HCl in vapor	g/m ³	0.000			
HF in vapor	g/m ³	0.000			
HBr in vapor	g/m ³	0.000			

Figure 6 VPC-Compass-SE predicts the risk of corrosion and electrochemical migration (ECM).

Under the specified package design and environmental conditions shown in Figure 6 above, the risk of corrosion and electrochemical migration is low as there exists barely enough electrolyte (moisture) to support the corrosion and/or ECM process. The predicted relative humidity in the internal volume is 17%, the predicted dew point temperature is -6.675°C, the predicted number of monolayers of water on the internal surface is 3, the predicted thickness of moisture film is 0.87 nm, and the predicted conductivity of surface moisture is $2.445 \times 10^{-11} \Omega^{-1} \cdot \text{cm}^{-1}$.

The powerful applications of VPC-Compass-SE are truly unlimited in packaging design design, corrosion prediction and reliability assessment, process control, trouble-shooting and failure analysis of microelectronic components and systems.

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VPC-Compass-SE, giving you the right directions in Prediction and Modeling of Corrosion in Microelectronic Components